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Environmental Framework for Soil Sampling Using Iot

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Abstract: *The population of India has reached over 1.2 billion, and the population level is growing. Therefore, after 25–30 years we can expect a difficult issue for food supplies, it is important to advance agribusiness. The main goal of this exploration is to test the measurement in the soil of the three noteworthy macronutrients (nitrogen (N), phosphorus (P), and potassium (K)) according to the farmer's. The soil sample sums N, P, and K are managed by comparing the solution with a shading map. This will represent N, P, and K as strong, moderate, and weak in self-restraint. The traditional procedures for agricultural land require human involvement. Nevertheless, human mediation can be restricted with this approach.*

Keywords: *Agriculture,Gas Sensor, IoT, Smart Agriculture, Soil Testing.*

I. INTRODUCTION

Soil Monitoring is a process and an effort to overcome the problem faced by the farmers in regards of soil quality which when performed in a wrong manner leads to various issues such as low productivity or no productivity in turn leading to a huge loss to the farmers which in an agricultural nation like India could be catastrophic. The proposed system is to make soil testing easier for farmers by making a portable system which can be used anywhere in the field hence, reducing the extra payload given by farmers in the traditional method of visiting labs for their soil tests. A soil test is a significant viewpoint for a few reasons: to upgrade crop generation (if a farmer knows about the soil nourishment he/she can choose the correct harvest that best suits the soil), to shield the earth from pollution by spillover and leakage of fertilizers(farmers being unconscious or because of inappropriate information discharge more fertilizers into their yield fields which might possibly improve the harvest however unquestionably harms the soil fertility), to help in the finding of plant development problems(for example, slow development, roots become elastic or decay, soil is always clammy), to improve the nutritional parity of the developing media and to save cash and preserve vitality by applying just the measure of manure required. Pre-plant media investigation gives a sign of potential supplement insufficiencies, pH awkwardness or abundance solvent salts. This is especially significant for cultivators who blend their own media. Media testing during the developing season is a significant device for overseeing crop sustenance and solvent salts levels. Pre-plant soil examining is basic for beneficial yield generation. Soil investigation can help choose the pre-plant manure application.

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II. NEED OF IoT

India is an agricultural country. India ranks second worldwide in farm output. At present, farmers have to get to soil testing labs to get their soil tested for macro-nutrients which are Nitrogen, Phosphorus and Potassium. For which they have to travel to other districts as there are only 5 government laboratory's which perform soil testing. And the existing system which could perform such test is expensive so by this proposed system we are trying to saving the time and money which cost farmers to travel laboratory or to by the buy the expensive equipment.

III. FEATURES

Features of Agricultural Soil Monitoring
(1) To overcome the issues in soil test for macro-nutrients.
(2) Ge the results instantly-With the use of this device farmers can instantly come to a conclusion over the quality of the soil and can respectively find the appropriate crop
(3) Cost Efficient-Since, it requires only minimum amount of electricity it turns out to be a cost effective solution contrary to traditional lab testing.
Advantages of Agricultural Soil Monitoring
(1) It reduces the time taken in travelling to laboratories-Due to lack of laboratories in villages a lot of time is wasted by farmers in travelling to cities
(2) It is easy to operate and to get the instant results-The device has been designed minimally with only required inputs thus easy to use
(3) Highly portable-The device is highly compact and can be easily carried anywhere.

IV. RELATED WORK

This method is developed in perspective for replacing the existing system which is to conduct the soil test in laboratories for which farmers have to travel a long distance for which they have to spend their time and resources or have to buy expensive equipment which most of them cannot afford [5].

A soil test is significant for a few motivations to streamline crop creation, to shield the earth from pollution by spillover and draining of abundance manure, to help in the finding of plant culture issues, to improve the nourishing equalization of the developing media and to save cash and preserve vitality by applying just the measure of manure required [4] .

The customary farm – land procedures require human intercession. With the mechanized innovation of water system, the human intercession can be limited. This method is suitable for all kind of soil [5],[6]. The testing method is automated by IoT. Use of this Proposed methodology will leads to get "Soil test for macro-nutrients" with less cost and the results will be provided to us as early as possible [11].

Agriculture development using technology is very much useful in cultivation. Without having an idea how to monitor the important parameters of the soil will leads us to have a problem in cultivation. To reduce this stress the authors developed a soil monitoring system. But there are no measures to test the soil as early as possible to produce the result and suggest the farmers what kind of crop may can possible to grow in that particular land [1].

The remote monitoring of the soil pH rate and its temperature rate has been done with the very minimal cost. This methodology focuses on the values viewed by the farmer's anywhere in the world at any time by using of web applications. Temperature sensor, Humidity sensor and soil moisture sensor are used. A reliable and continuous vital sign monitoring system is developed successful. This system was also low in power and cost, noninvasive and provisional real time monitoring on the agriculture. But there are no availability of soil testing. It can monitor the pH level but there are no possibility to provide the accurate result in detail to test the soil [2],[7],[8].

Authors proposed the new system to help the farmers to develop the agricultural production. Here they projected the soil testing by means of the three types of sensors not by the natural gas availability. More over images of the fields is shared to the server, it may leads to have a lack of knowledge about the soil available in the land [3],[9],[11].

V. MOTIVATION

The motivation for this research work came when I was watching news in which it was describing how agriculturalists of India are struggling to get their soil sample tested as there are only Limited Number of laboratories in our Country to which they have to travel other districts for which they will be spending their valuable time as well as money.Problem was that people were just talking to help them but no one was taking an incentive and there was no proper guidance or instruction given to farmers by which they could improve their cultivation of crops.A few components involve in the development and advancement of plants, and those assimilated from the soil are commonly known as plant supplements. Other than these, the plant takes up carbon, oxygen and hydrogen, either from the air or from the water consumed by roots. On the whole, 16 components have been recognized and are set up to be fundamental for plant development. There are carbon (C), hydrogen (H), Oxygen (O), nitrogen (N), phosphorus(P), potassium (K), calcium(Ca), magnesium (Mg), iron (Fe), Sulfur (S), zinc (Zn), manganese (Mn), copper (Cu), boron (B), molybdenum (Mo), and chlorine(Cl). These components fill in as crude materials for development and improvement of plants, and arrangement of foods grown from the ground.

The soil are examined and grouped by their utilization which is named as land ability characterization. In this grouping, natural soil trademark, outer land features and ecological components are given conspicuousness. For this reason, soil study is done to record the harvest restricting variables, for example, soil profundity, geography, surface structure, and water holding limit, seepage highlights, trailed by assessment of soil ripeness status, in light of soil testing/investigation. The soil are along these lines characterized in to 8 classes, four of which are viewed as reasonable for agricultural reason (Class I and IV) and Class V to VIII are non-arable grounds and can be utilized for farming and backwoods and need solid protection measures. A viable linkage between soil testing and soil overview is valuable to guarantee plan of a sound soil fertility assessment customized.

VI. SYSTEM BLOCK DIAGRAM

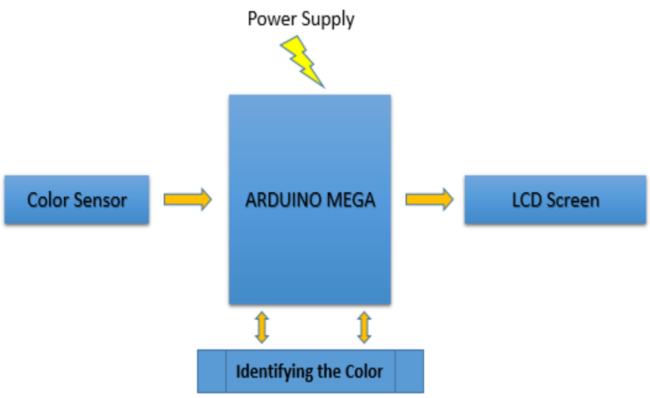

Fig1. Agricultural Soil Testing System Block Diagram

Data collects from sensors, sends to Arduino. If the value is greater than threshold value then it will display message exceeded.

TABLE 1

S.No	Input	Expected Output	Actual Output	Result
1	Color Sample	Nitrogen Level is Medium	Not Matching Values	Fail
2	Color Sample	Nitrogen Level is Medium	Nitrogen Level is Medium	Pass

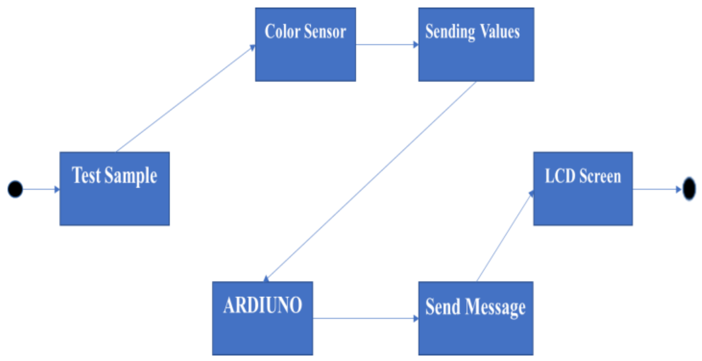

Fig2. Agricultural Soil Testing System work flow

Sample soil is given it to the color sensor module after applying the soil testing chemicals for finding the soil macronutrients level. The Arduino mega will find the threshold value of the macronutrients using the predefined color coded values. If the value is greater than threshold value then it will display message according to the macronutrients level whether it's high, medium or low with the macronutrients name.

VII. DEVICE DETAILS

Table2 :Device Detail

S.No	IoT Device	Description
1	Arduino Mega	Serial communication interfaces, including Universal Serial Bus(USB),Which allows the programmer to code.
2	Jump Wires	22 AWG(0.33 mm2) solid copper, tin-plated wire.
3	LCD Screen	A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two register, namely, Command and Data.
4	Potentiometer	It is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.
5	Color Sensors	The TCS3200 and TCS3210 programmable color- light-to-frequency converters that combine configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit.

[1] Nitrogen Test case

Table2:Nitrogen Test Cases With Expected Output and Actual Output

By using of table2 we can see that at the time of testing there was pink color sample so message which is displayed is "Nitrogen level is medium". Also, displayed values are the calibration values.

SOIL TESTING PROCESS

This test is conducted by the help of a color chart which had the predefined color values which indicate the level of macro nutrients present in soil.

Fig3. Color Chart details for Nitrogen, Phosphorus and Potassium

Fig4. Test output on IoT Device for Nitrogen Testcases

[2] Phosphorus Test Case:

Table3. Phosphorus Test Cases With Expected Output and Actual Output

S.No	Input	Expected Output	Actual Output	Result
1	Color Sample	Phosphorus Level is High	Not Matching Values	Fail
2	Color Sample	Phosphorus Level is High	Phosphorus Level is High	Pass

By using of table3 we can see that at the time of testing there was Blue color sample so message which is displayed is "Phosphorus Level is High". Also, displayed values are the calibration values.

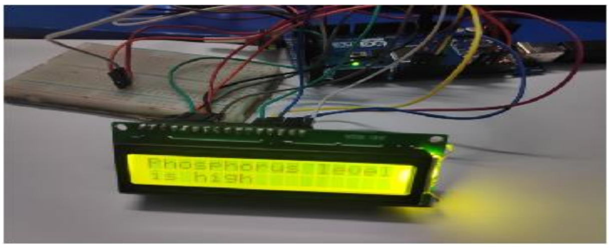

Fig5. Test output on IoT Device for Phosphorus Test cases

[3] Potassium Test Case:

Table4. Potassium Test Cases With Expected Output and Actual Output

S.No	Input	Expected Output	Actual Output	Result
1	Color Sample	Potassium Level is high	Not Matching Values	Fail
2	Color Sample	Potassium Level is high	Potassium Level is high	Pass

By using of table4 we can see that at the time of testing there was White color sample so message which is displayed is “Potassium Level is high”. Also, displayed values are the calibration values

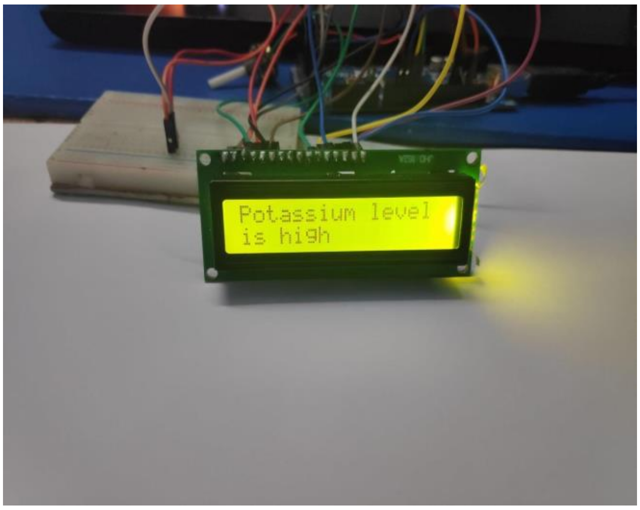

Fig6. Test output on IoT Device for Potassium Test cases

Based on the output of figures 4,5 & 6. We can suggest the farmers to suggest what kind of crops they may can grow in their land. By doing this, we can reduce the testing time of the soil for the farmers land. They don't want to travel must distance to test their land soil. Traveling time and the money going to spend for the travel also reduced.

Table5.Represents NPK Chat as per the Tamilnadu Region Trained Data Range From Low To High

Nutrient	Low	Medium	High
Available nitrogen (N)	< 240Kg/ha	240-480kg/ha	> 480Kg/ha
Available Phosphorus (P)	< 11.0 Kg/ha	11 – 22 Kg/ha	> 22 Kg/ha
Available potassium (K)	< 110Kg/ha	110-280Kg/ha	> 280Kg/ha

The following the analyses is observed from sampling data which is collected from various land filed in tamil nadu. the graphs indicated the NPK values as per the above table5.

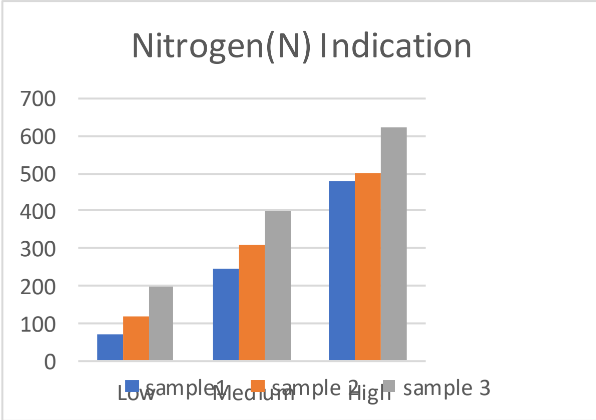

Fig7.Nitrogen(N) test data

In Fig.7 represents nitrogen levels as per the sample data with respect to trained data set

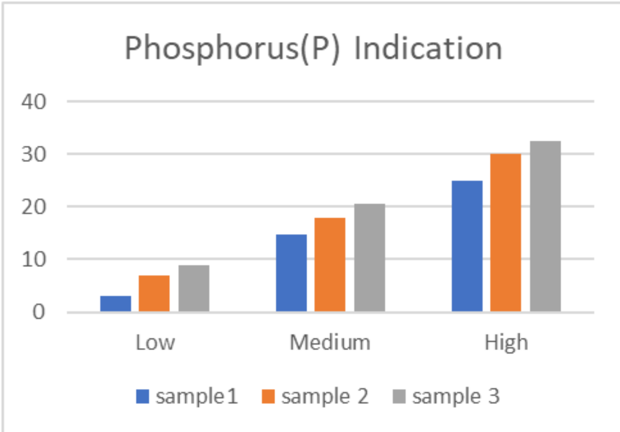

Fig8. Phosphorus(P) test data

Phosphorus indication sources different levels collected samples in Fig.8 as per the trained data set

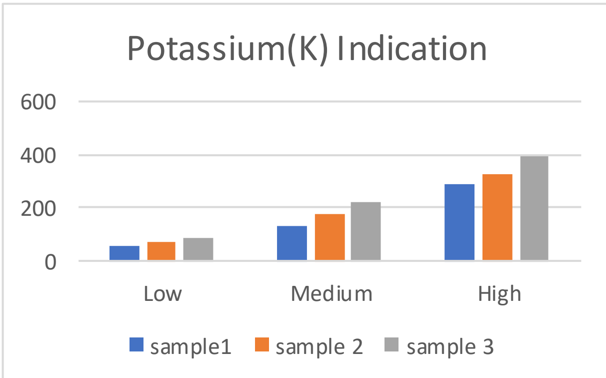

Fig9. Potassium(k) test data

Potassium indication sources different levels collected samples in Fig.9 as per the trained data set

VIII. CONCLUSION AND FUTURE WORK

By the help of the proposed IoT system it is much easier to operate and the cost for making is very low.

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As this product is of low cost it could be easily replaced and could be experimented a lot, and this embedded system uses (Internet of Things) so, it could be used in more efficient and advance manner as the size of this product is very small and get fitted any place easily. For the further scope I suggest making the results to be displayed in regional languages like Hindi, Telugu, and Punjabi, etc. This could help the people who don't understand English to interpret the results and implement on it or by providing a user manual in native language. This also could be improved by making a collection on results after the test and predict the future soil nutrients by the help of machine learning and artificial intelligence. By doing this, the government can also help the farmer community directly by checking their data sets and provide assistance for recommending a crop for farming.

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